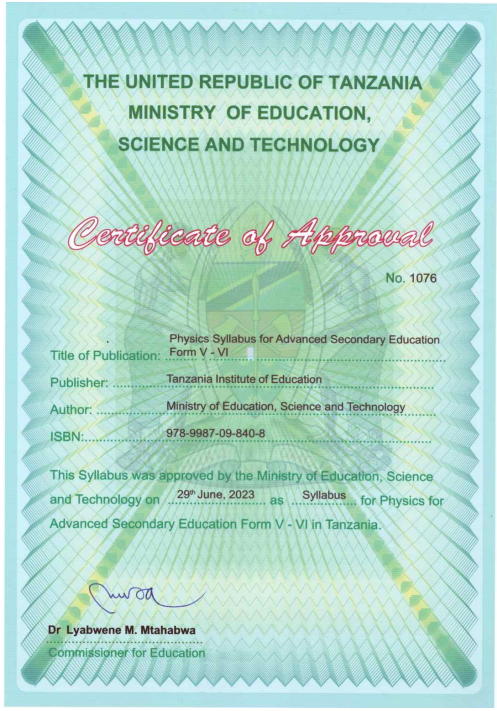
THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY



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SCIENCE AND TECHNOLOGY

Certificate of Approval

No. 1076

Title of Publication: Physics Syllabus for Advanced Secondary Education Form V - VI

Publisher: Tanzania Institute of Education

Author: Ministry of Education, Science and Technology

ISBN: 978-9987-09-840-8

This Syllabus was approved by the Ministry of Education, Science and Technology on 29th June, 2023 as Syllabus for Physics for Advanced Secondary Education Form V - VI in Tanzania.

Dr Lyabwene M. Mtahabwa
Commissioner for Education

PHYSICS SYLLABUS FOR ADVANCED SECONDARY EDUCATION FORM V-VI

2023

Published 2023

ISBN: 978-9987-09-840-8

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This document should be cited as: Ministry of Education, Science and Technology. (2023). *Physics Syllabus for Advanced Secondary Education Form V-VI.* Tanzania Institute of Education.

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Abbreviations and Acronyms

ICT	Information and Communication Technology
TIE	Tanzania Institute of Education

Acknowledgements

Several specialists from both Government and non-government institutions contributed to the development of the Physics Syllabus for Advanced Secondary Education Form V-VI. The Tanzania Institute of Education (TIE) would like to express its sincere gratitude to all the experts who contributed in the development of this syllabus, including the lecturers, tutors, school quality assurance officers, teachers and TIE curriculum developers. The Institute is also appreciative of the professional National Technical Committee that was established by the Minister for Education, Science and Technology to oversee the curriculum review process for pre-primary, primary, secondary and teacher education. The Committee met its obligations in professional manner by ensuring that this syllabus reflects graduates with the abilities to establish their own business, find employment, and be able to support themselves, which is in line with the primary objective of the 2023 curricular review.

Finally, TIE thanks the Ministry of Education, Science and Technology in a special way for facilitating the preparation and distribution of this syllabus.

Dr Aneth A. Komba
Director General
Tanzania Institute of Education

1.0 Introduction

Physics for Advanced Secondary Education is a compulsory subject for students who choose to join the Natural Science stream taking Physics among the subjects in their combination. The purpose of learning Physics is to provide students with a contemporary and coherent understanding of energy, matter and their interrelations by focusing on investigating natural phenomena and then applying concepts, principles, theories and laws to explain the physical behaviour of the universe. Furthermore, the subject aims to promote students with scientific skills and other skills related to critical thinking, creativity and innovation, communication and collaboration. It also serves as a bridge to enable students appreciate the values of resources present in Tanzania and develop the ability to create works for self-employment.

This syllabus is designed to guide the teaching and learning of Physics for Advanced Secondary Education Form V-VI in the United Republic of Tanzania. The syllabus interprets the competences indicated in the 2023 Advanced Secondary Education Curriculum. It provides information that will enable teachers to plan their teaching process effectively. It also provides teaching and learning opportunities that guide teachers to apply different methods and strategies to enable students develop 21st Century skills which include critical thinking, creativity, communication, collaboration and problem solving.

2.0 Main Objectives of Education in Tanzania

The main objectives of education in Tanzania are to enable every Tanzanian to:

(a) Develop and improve his or her personality so that he or she values himself or herself and develops self-confidence;

(b) Respect the culture, traditions and customs of Tanzania; cultural differences; dignity; human rights; attitudes and inclusive actions;

(c) Advance knowledge and apply science and technology, creativity, critical thinking, innovation, cooperation, communication and positive attitudes for his or her own development and the sustainable development of the nation and the world at large;

(d) Understand and protect national values, including dignity, patriotism, integrity, unity, transparency, honesty, accountability and the national language;

(e) Develop life and work-related skills to increase efficiency in everyday life;
(f) Develop a habit of loving and valuing work to increase productivity and efficiency in production and service provision;
(g) Identify and consider cross-cutting issues, including the health and well-being of the society, gender equality, as well as the management and sustainable conservation of the environment; and
(h) Develop national and international cooperation, peace and justice per the Constitution of the United Republic of Tanzania and International Conventions.

3.0 Objectives of Advanced Secondary Education

The objectives of Advanced Secondary Education are to:

(a) Strengthen, broaden and develop a deeper understanding of the knowledge, skills and attitudes developed at the Ordinary Secondary Education;
(b) Safeguard customs and traditions, national unity, national virtues, democracy, respect for human and civil rights, duties and responsibilities associated with such rights;
(c) Develop self-confidence and the ability to learn in various fields, including science and technology as well as theoretical and technical knowledge;
(d) Improve the use of language in academic communication;
(e) Strengthen accountability for cross-cutting issues, including health, security, gender equality and sustainable environmental conservation;
(f) Develop competence and various skills which will enable the student to employ himself or herself, to be employed and to manage his or her life by exploiting his or her environment well; and
(g) Develop readiness to continue to a college education.

4.0 General Competences for Advanced Secondary Education

The general competences for Advanced Secondary Education are to:

(a) Apply the knowledge and skills acquired in Ordinary Secondary Education to strengthen and broaden academic understanding;
(b) Demonstrate an appreciation of citizenship, national virtues, human rights and civil rights;
(c) Demonstrate confidence in learning various fields, including Science and Technology, theoretical knowledge and vocational education;
(d) Use language skills in academic communication;
(e) Apply knowledge of cross-cutting issues to master the surrounding environment;
(f) Use knowledge and skills to enable him/her to employ oneself, be employed as well as manage life and his/her environment; and
(g) Demonstrate readiness to proceed to the next level of education.

5.0 Main and Specific Competences

The main and specific competences to be developed are presented in Table 1.

Table 1: *Main and Specific Competences for Form V-VI*

Main competences	Specific competences
1.0 Demonstrate mastery of concepts, theories and principles in Physics	1.1 Demonstrate an advanced understanding of the concepts, theories and principles in Physics 1.2 Use various instruments to carry out measurements in Physics 1.3 Analyse the efficacy of different techniques and instruments in physical measurements
2.0 Conduct experiments in Physics	2.1 Carry out experiments in Physics
3.0 Conduct a project in Physics	3.1 Conduct a project in Physics

6.0 Roles of Teachers, Students and Parents in Teaching and Learning Process

A good relationship between teachers, students and parents/guardians is fundamental in ensuring successful learning. This section outlines the roles of each participant in facilitating effective teaching and learning Physics.

6.1 The teacher

The teacher is expected to:

(a) Help the student to learn and acquire the intended competences in Physics;
(b) Use teaching and learning approaches that will allow the students with different needs and abilities to:
    (i) develop the competences needed in the 21st Century; and
    (ii) actively participate in the teaching and learning process.
(c) Use student centred instructional strategies that make the student a centre of learning which allow them to think, reflect and search for information from various sources;
(d) Create a friendly teaching and learning environment;
(e) Prepare and improvise teaching and learning resources;
(f) Conduct formative assessment regularly by using tools and methods which assess theory and practice;
(g) Treat all students equally irrespective of their differences;
(h) Protect the student while at school;
(i) Keep track of the student's daily progress;
(j) Identify individual student's needs and provide the right interventions;
(k) Involve parents/guardians and the society at large in the student's learning process; and
(l) Integrate cross-cutting issues and ICT in the teaching and learning process.

6.2 The student

The student is expected to:

(a) Develop the intended competences by participating actively in various learning activities inside and outside the classroom; and
(b) Participate in the search for knowledge from various sources, including textbooks, reference books and other publications in online libraries.

6.3 The parent/guardian

The parent/guardian is expected to:

(a) Monitor the child's academic progress in school;
(b) Where possible, provide the child with the needed academic support;
(c) Provide the child with a safe and friendly home environment which is conducive for learning;
(d) Keep track of the child's progress in behaviour;
(e) Provide the child with any necessary materials required in the learning process; and
(f) Instil in the child a sense of commitment and positive value towards education and work.

7.0 Teaching and Learning Methods

The teaching and learning methods are instrumental in developing student's competences. This syllabus suggests teaching and learning methods for each activity which includes but not limited to discussions, presentations, field visits, practical work, research, scientific experiments, and project works. However, a teacher is advised to plan and use other appropriate methods based on the environment or context. All the teaching and learning methods should be integrated with the everyday lives of students.

8.0 Teaching and Learning Resources

The process of teaching and learning requires different resources. In that regard, both the teacher and students should work together to collect or improvise alternative resources available in the school and home environment when needed. The teacher and student are expected to constantly seek for information from various sources to effectively facilitate teaching and learning process. The list of approved textbooks and reference books shall be provided by TIE.

9.0 Assessment of the Learning Process

Assessment is important in teaching and learning of Physics subject. It is divided into formative and summative assessments. Formative assessment informs both the teacher and students on the progress of teaching and learning, and in making decisions on improving the teaching and learning process. Teachers are, therefore, expected to apply a wide range of formative assessment methods which include but not limited to discussions, presentations, oral questions, brainstorming, experiments, observations, practical and projects.

Summative assessment, on the other hand, will focus on determining student's achievement of learning. Teachers are expected to use a variety of summative assessments including mid-term tests, terminal, mock examinations and projects. The scores obtained from these assessments will be used as Continuous Assessment (CA). Therefore, the continuous assessments shall contribute 30% and the National Form VI Examination shall be 70% of the student's final achievement, as indicated in Table 2.

Table 2: *Contribution of Continuous Assessment and National Examination in the final score*

Type of Assessment	**Form V**	**Form VI**
First Term Examination	5%	6%
Second Term Examination	5%	-
Project	-	7%
Mock Examination	-	7%
National Examination	-	70%
Total	**100%**	

10.0 Number of Periods

This syllabus provides estimates of the time that will be spent in teaching and learning taking into consideration the complexity of the specific competences and the learning activities. Ten periods of 40 minutes each have been allocated for this subject per week.

11.0 Contents of the Syllabus

The contents of this syllabus are presented in matrix form with seven columns which include main competences, specific competences, learning activities, suggested methods, assessment criteria, suggested resources and number of periods as presented in Tables 3-4.

Form V

Table 3: *Detailed Contents for Form V*

Main competences	Specific competences	Learning activities	Suggested teaching and learning methods	Assessment criteria	Suggested resources	Number of periods
1.0 Demonstrate mastery of concepts, theories and principles in Physics	1.1 Demonstrate an advanced understanding of the concepts, theories and principles in Physics	(a) Explain the fundamental principles of measurement (*dimensional analysis, precision, accuracy* and *uncertainties*)	**Think-ink-pair-share:** Give opportunity to students to perform individual tasks on the fundamental principles of measurements and allow them to share with others **Hands-on activities:** Provide students with the opportunity to engage in real-world activities related to the fundamental principles of measurements	Fundamental principles of measurements are clearly explained	Metre rule, Vernier calipers, voltmeters, ammeters, micrometer screw gauge, weighing scales/ balances, timers or stopwatches, protractor and oscilloscope	105
		(b) Describe the basic tenets of mechanics and	**Interactive digital simulation:** Guide students through interactive demonstrations,	Concepts and principles related to mechanics are correctly described	Balls, conical pendulum, banked road, water in bucket, telescope, solid object, Earth	

Main competences	Specific competences	Learning activities	Suggested teaching and learning methods	Assessment criteria	Suggested resources	Number of periods
		two dimensional motion (*projectile motion, circular motion, rotation, gravitation* and *fluid mechanics*)	explanations, hands-on activities and questions to describe the basic tenets of mechanics and two dimensional motion		globe, Armfield F1-15, Bernoulli's apparatus test equipment, calipers or metre rules, jug, F1-10 hydraulic bench, stopwatch and electric motor	
		(c) Describe the fundamental concepts, principles and theories underlying the thermal properties of materials *(heat transfer, kinetic theory*	**Scenario:** Guide students to discuss some scenarios related to transfer of heat or radiation in different materials **Virtual simulation:** Allow students to explore and manipulate thermal properties of materials virtually	Concepts, principles and theories underlying the thermal propertiesof materials are correctly described	Fridge, power supply, water pump, stopwatch, metal cans, thermometers, calorimeter and thermocouple thermometers, calorimeter and thermocouple	

Main competences	Specific competences	Learning activities	Suggested teaching and learning methods	Assessment criteria	Suggested resources	Number of periods
		of solids, liquids and gases, thermodynamics and *thermal radiation)*	**Practical work:** Guide students to carry out experiments on thermal properties of materials related to their real-life experiences			
		(d)Explore the basic tenets of vibrations and waves (*simple harmonic motion, and wave propagation {interference, diffraction* and *polarization})*	**Group discussion:** Facilitate group discussions for students to share their observations and ask questions about basic tenets of vibrations and waves **Interactive simulation and virtual labs:** With the aid of videos, animations, and online sources, provide opportunity for students to conduct virtual and hands-on experiments related to vibrations and waves	Concepts, theories and principles related to vibrations and waves are correctly described	Inextensible string, pendulum bob, resonance apparatus, springs and masses, ripple tank, microphone, loudspeaker and oscilloscope	

Main competences	Specific competences	Learning activities	Suggested teaching and learning methods	Assessment criteria	Suggested resources	Number of periods
			Problem-based learning: Provide students with scenarios or case studies that require them to apply the theories and principles of vibrations and waves they have learnt to solve practical problems			
		(e) Explain the concept, theories and principles of electrostatics (*electric field, electric potential* and *capacitance*)	**Think-ink-pair-share:** Guide students to perform individual tasks on the concepts, theories and principles of electrostatics then ask them to share with others **Practical work:** Guide students in groups to perform hands-on activities of electrostatics related to their real-life experiences	Concept, theories and principles of electrostatics are correctly explained	Plastic rods, glass rods, voltmeter, capacitance meter, multimeter, potentiometer, metre bridge, electroscope, metal plate and battery	

Main competences	Specific competences	Learning activities	Suggested teaching and learning methods	Assessment criteria	Suggested resources	Number of periods
			Field trip: Organise a field trip to help students visit places where electrostatic sprays, painting and photocopying activities are done			
	1.2 Use various instruments to carry out measurements in Physics	(a) Use various instruments to carry out experiments in mechanics, vibrations and waves, thermal properties of materials and electrostatics	**Hands-on activities:** Guide students to use various instruments to conduct experiments related to mechanics, vibrations and waves, thermal properties of materials and electrostatics **Project work:** Guide students by using scenarios or case studies, to work on a certain project and come up with a scientific solution	Various measuring instruments are applied accordingly in mechanics, vibrations and waves, thermal properties of materials and electrostatics	Flow-tube, thermometers, Vernier calipers, pendulum, inclined planes, ripple tanks, tuning fork, spectrometer, thermocouple, CRT (Cathode Ray Tube) sonometer, stopwatch, retort stand and steel balls of varying diameters	55

Main competences	Specific competences	Learning activities	Suggested teaching and learning methods	Assessment criteria	Suggested resources	Number of periods
		(b) Analyse the precision and accuracy of measurements	**Group discussion:** Facilitate group discussions for students to share their experiences and ask them some questions on the precision and accuracy of measurements	Precision and accuracy of measurements is correctly processed	Research reports	
	1.3 Analyse the efficacy of different techniques and instruments in physical measurements	(a) Analyse the strengths and weaknesses of various instruments and techniques used in mechanics, vibrations and waves, thermal properties of materials and electrostatics	**Problem-based learning:** Guide students to analyse the strengths and weaknesses of instruments and techniques used in mechanics, vibrations and waves, thermal properties of materials and electrostatics	Strengths and weaknesses of various techniques and instruments used in physical measurements are correctly analysed	Scientific journals, research papers and online resources	38

Main competences	Specific competences	Learning activities	Suggested teaching and learning methods	Assessment criteria	Suggested resources	Number of periods
2.0 Conduct experiments in Physics	2.1 Carry out experiments in Physics	(a) Design and carry out scientific experiments related to mechanics, vibrations and waves, thermal properties of materials and electrostatics	**Hands-on experiments:** Guide students to observe phenomena and perform experiments related to mechanics, vibrations and waves, thermal properties of materials and electrostatics and allow them to discuss on their real-world applications	Experiments are designed and carried out according to underlying procedures	Calorimeters, thermometers, source of heat, micrometer screw gauge, slotted weights, metre rule, ripple tank, resonance tube and Vernier calipers	120
		(b) Use ICT tools to analyse and present data (*Ms Excel, PSPP, R, MATLAB, Python* and *Origin*)	**Hands-on activities:** Guide students through interactive demonstrations and explanations to manipulate data using ICT tools	Data are analysed and presented using ICT tools	Scientific journals, research papers and online resources	

Main competences	Specific competences	Learning activities	Suggested teaching and learning methods	Assessment criteria	Suggested resources	Number of periods
		(c) Use various methods to disseminate scientific results in Physics (*reports, journal articles* and *case studies*)	**Problem-based learning:** Provide students with real-world problems or challenges related to scientific investigations and allow them to prepare reports and disseminate them	Various methods are used to disseminate scientific results		
3.0 Conduct a project in Physics	3.1 Conduct a project in Physics	(a) Design and carry out a research project in Physics	**Problem solving:** Guide students in groups to think critically on the best methods they can apply in solving scientific challenges faced in their environment	Research project has been designed and carried out by considering scientific procedures	Field reports, journal papers, research reports and online resources	72

Main competences	Specific competences	Learning activities	Suggested teaching and learning methods	Assessment criteria	Suggested resources	Number of periods
			Project work: Guide students on project development process then task them to develop a research project related to Physics			

Form VI

Table 4: *Detailed Contents for Form VI*

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
1.0 Demonstrate mastery of concepts, theories and principles in Physics	1.1 Demonstrate an advanced understanding of the concepts, theories and principles in Physics	(a) Explain the principles, theories and concepts of current electricity (*direct and alternating current* and *electrical networks*)	**Brainstorming:** Guide students in groups to brainstorm on the applications of current electricity in their environment **Multimedia approach:** Guide students to utilise interactive digital sources to explore the hands-on activities to explain the principles, theories and concepts of current electricity **Practical work:** Guide students to explore on principles, theories and concepts of current electricity through hands-on activities	Principles, theories and concepts of current electricity are clearly explained	Connecting wires, resistors, power sources, electrical devices, Wheatstone bridge, potentiometers, ammeters, jockeys and discharge tube	180

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
		(b) Explore the basic tenets of electromagnetism (*electromagnetic force, induction* and *electromagnetic waves*)	**Group discussion:** Facilitate group discussions for students to share their experiences on the basic tenets of electromagnetism and ask them some questions related to those concepts **Multimedia approach:** Use interactive computer simulations and animations to provide a virtual environment for students to explore and manipulate variables related to electromagnetism	Principles underlying the phenomenon of electromag-netism are correctly explored	Magnet, transformer, oscilloscope, iron fillings, conductors, coils, solenoid, galvanometer, battery, ballistic galvanometer, compass and deep needle	

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
			Hands-on experiments: Conduct hands-on experiments that demonstrate the principles of electromagnetism			
		(c) Explore the basic tenets of electronics and telecommunication (*band theory, semiconductors, transistors, logic gates* and *satellites*)	**Flipped classroom:** Assign students some activities to visit nearby small workshops for learning about different electronic components and devices in which they are used **Cooperative learning:** Guide the students to share their experiences and understanding on the basic tenets of electronics and telecommunication	Concepts and principles related to electronics and telecommu-nication are correctly described	Power sources, conductors, semi-conductors, insulators, tri-valent and pentavalent elements, diodes, transistors, lamps, resistors, ammeters, voltmeters, capacitors, oscilloscope,	

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
			Project work: Facilitate students to do projects using concepts, theories, principles and laws in the field of electronics and telecommunication to develop prototype devices **Multimedia approach:** Guide students by utilizing interactive digital sources to explore the hands-on activities which will enable the students to describe the concepts and principles related to electronics and telecommunication		signal generator, bulb, logic gates, op amp, radio set, TV set, MP3 system, mobile phone, radio station, TV station and TV antennas	

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
		(d) Explore some advanced tenets of atomic Physics (*atomic transitions, nuclear physics, LASER, X-rays, α, β* and *γ radiations*)	**Multimedia approach:** Guide students by utilising interactive digital sources to explore the hands-on activities related to the advanced tenets of atomic physics **Field trip:** Organise a field trip to a nearby institution dealing with the applications of atomic physics for students to learn	Concepts and principles related to atomic physics are correctly described	Hydrogen spectral lamb, diffraction grating, prism spectrometer, power supply, photocell, light source, prism, micro-ammeter, voltmeter, X-ray tube, He-Ne laser, screen, models, radioactive sources, GM tube, scaler counter and timer	

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
		(e) Explore the basic tenets of energy and energy sources (*solar radiation, wind energy, hydropower* and *thermal reactors*)	**Inquiry-based learning:** Ask students to explore the basic tenets of energy and their sources through guiding questions and resources **Field trips and guest speakers:** Organize field trips to a nearby energy facilities or invite guest speakers to share their experiences with students about energy sources and guide the students to write a report	Principles and concepts of energy sources are correctly explored	Diagram of hydro-electric power plant, hydro-electric plant, reference books, solar cell testers, wood, solar panel, photovoltaic (solar), cell, solar cells, model of solar panel, wind, feathers, cotton wool, wind mills, thermometers, wind data loggers, flowmeters and pressure transducers	

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
		(f) Explore the basic tenets of medical Physics (*nervous system, electro-cardiography, diagnostic imaging* and *radiotherapy*)	**Multimedia approach:** Guide students to explore resources such as videos that explain the physical concepts, theories and principles used in medical Physics **Field trip:** Organise the study tour to nearby hospitals where students can explore various imaging devices such as ultra sound and X-ray machines	Physical concepts, theories and principles used in medical Physics are clearly explained	Various models, various diagnostic, radiotherapy and mammography machines, MRI machine, CT scanners, X-ray machine, linear accelerator, Radiation detectors, dosimeters, ultrasound meter and hospitals	

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
	1.2 Use various instruments to carry out measurements in Physics	(a) Use various instruments to carry out experiments in current electricity, electromagnetism, electronics, telecommunication, energy sources, medical physics and atomic physics **Interactive simulation:** Facilitate students to visualize and understand the use of various measuring instruments used in current electricity,	**Problem-based learning:** Guide students with real-world problems related to current electricity, electromagnetism, electronics, telecommunication, energy sources, medicine and atomic physics which require the use of instruments to measure their quantities	Various measuring instruments of current electricity, electro-magnetism, electronics, telecommu-nication, energy sources, medicine and atomic physics are correctly used	Audio/ audio-visual materials	35

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
		electromagnetism, electronics, telecommunication, energy sources, medical Physics and physics of the atom				
	1.3 Analyse the efficacy of different techniques and instruments in physical measurements	(a) Analyse the strengths and weaknesses of the various instruments and techniques used in current electricity, electromagnetism, electronics, telecommunication, energy sources, medical physics and atomic Physics	**Group discussion:** Guide students in manageable groups to examine the strengths and weaknesses of various instruments as well as techniques used in scientific investigations	The strengths and weaknesses of various measuring instruments and techniques used in Physics are appropriately analysed	Various measuring instruments, journal papers, research articles and online resources	40

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
2.0 Conduct experiments in Physics	2.1 Carry out experiments in Physics	(a) Design and carry out scientific experiments related to current electricity, electromagnetism, electronics, telecommunication, energy sources, medical physics and atomic physics	**Interactive simulation:** Facilitate students to use virtual labs to carry out scientific investigations related to the given concepts **Practical work:** Guide students using real laboratory instruments to perform scientific investigations related to the given concepts **ICT based learning:** Guide students with the proper use of ICT facilities to present scientific investigation reports	Experiments related to current electricity, electro-magnetism, electronics, telecommu-nication, en-ergy sourc-es, medical Physics and atomic physics are correctly designed and carried out	Various measuring instruments, reference textbooks and online resources	85

Main competences	Specific competences	Learning activities	Suggested teaching and learnimg methods	Assessment criteria	Suggested resources	Number of periods
3.0 Conduct a project in Physics	3.1 Conduct a project in Physics	(a) Complete and submit a report for the research project started in Form Five	**Practical work:** Guide the students using hands-on activities to appraise and improve the prototypes developed to solve the identified social or scientific problems **Problem-based learning:** Appraise and improve the prototypes developed to solve the identified social or scientific problems	Projects have been completed and report submitted	Field reports, journal papers and research reports	50

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